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Relationships were studied between the AAHPER Youth Fitness Test, primarily a measure of motor fitness, and Cooper's Twelve-Minute Test, a field test for cardiorespiratory fitness. The two tests were administered to forty-seven women physical education majors at The University of North Carolina at Greensboro.

Correlation coefficients were determined by means of the Pearson r using the original data. The .05 level of confidence was considered acceptable for these coefficients. Significant relationships were found between the t-score totals of the AAHPER test and both the distance covered and the fitness categories of the Twelve-Minute Test. Other significant relationships were found between each item of the AAHPER battery and the T-score total of the battery. Five of these items, the 600-yard walk-run, softball throw, standing broad jump, shuttle run, and bent-arm hang, also were significantly related to the Twelve-Minute Test.

It was concluded that the two tests could not be used interchangeably although they are related significantly. None of the items of the AAHPER battery is closely enough related to be used to replace either the total battery or the Twelve-Minute Test. However, the relationships which were significant indicate that both tests are probably at least partial indicators of both motor and cardiorespiratory fitness. For the purposes of testing large groups of subjects, the Twelve-Minute Test serves well as a sound measure of fitness which is administratively efficient.

THE RELATIONSHIP BETWEEN THE AAHPER YOUTH FITNESS TEST AND THE TWELVE-MINUTE TEST

by

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

> Some objectives have been accepted by most physical educators throughout the years. Development of physical stamina, organic stimulation, over-all muscular efficiency, and efficient functioning of the entire body in motor performance are four long-term objectives almost universally accepted. (17:276)

Today, these terms have been replaced by fitness, and more specifically physical fitness. There is much disagreement over what constitutes physical fitness, what the physical educator's responsibilities are toward the development of it, and how it can best be measured. Nevertheless, philosophical differences cannot alter the fact that physical educators have an obligation of a unique type concerning fitness education.

Steinhaus suggests that "every teacher effort to increase the quantity and quality of human life is fitness education." (18:15) Physical educators have traditionally used "as their tool for total fitness the neuromuscular aspects of man." (16:92) In fact, physical education has, according to Oberteuffer and Ulrich, "the unique opportunity to help people attain an organic well-being through activity." (16:95)

Cooper challenges the physical education profession to "apply modern scientific techniques and provide the much needed data" concerning conditioning and training programs for the medical profession in exercise and preventive and rehabilitative

medicine. (30:22) In reference to physical fitness, he says, "the specialist in health and physical education must bear the responsibility for advancing the state of the art and answering many questions." (30:22)

Interest in fitness in this country has waxed and waned with the presence or absence of some stimulant such as war or, at times, provocative new findings in the field. One of the more recent trends of interest resulted from the Kraus-Weber studies of the mid-fifties which led to the development of a battery of test items known as the Youth Fitness Test of the American Association for Health, Physical Education, and Recreation, hereafter referred to as the AAHPER Youth Fitness Test. Although this is the most widely used test of fitness, much dissatisfaction is expressed by those who use it. The major complaint lies in the amount of time required to administer it to large groups.

In the past few years, with the publication of the book, Aerobics, there has been a renewal of interest concerning physical fitness among physical educators and even among the general public. Dr. Kenneth H. Cooper, the author of Aerobics, stimulated this interest through the ideas he expressed about the information gathered from testing large numbers of Air Force personnel. The results of his work have provided a simple field test which has been validated against a laboratory criterion measuring oxygen consumption.

Several others have attempted to compare the results of the AAHPER Youth Fitness Test to laboratory measures of organic

fitness. (39, 40, 56, 72, 74) No attempt has been made, however, to compare the total AAHPER battery with the indirect measure of maximum oxygen consumption advocated by Cooper's Aerobics, the Twelve-Minute Test. Should a strong positive relationship exist between these two tests, those who are interested in evaluating fitness in their programs may find this shorter test appropriate for their needs.

STATEMENT OF THE PROBLEM

The purpose of this study was to determine the relationship between the AAHPER Youth Fitness Test and the Twelve-Minute Test. The relationships were studied in the following ways:

1. by correlating the total scores on each test,
2. by correlating the individual items in the AAHPER battery with the total AAHPER battery scores,
3. by correlating each item on the AAHPER test with the Twelve-Minute Test score, and
4. by correlating the total T-scores of the AAHPER battery items with the fitness categories defined by Cooper.

LIMITATIONS

This study was limited in the following ways:

1. The subjects were limited to the women physical education majors at The University of North Carolina at Greensboro who volunteered to participate.

2. The testing sessions were controlled neither for weather conditions nor time of day.
3. The writer totaled the T-scores on the AAHPER test items and used the total as a composite picture of motor fitness.
4. Although some type of warm-up was suggested, there was no uniformity in the warm-up taken by subjects.
5. No control was attempted over motivation. All subjects were volunteers, however, who evidenced some degree of interest. No pressure whatsoever was placed upon any of them to participate.

DEFINITIONS

Aerobics - the production of energy for muscle contraction during which oxygen is utilized at a rate sufficient to provide for the continuance of carbohydrate breakdown to carbon dioxide and water. (8)

Anaerobics - the production of energy for muscle contraction during which insufficient oxygen is utilized to keep pace with the volume needed to provide the complete breakdown of the carbohydrate so that the end product is an accumulation of lactic acid and an oxygen debt. (8)

Maximum Oxygen Intake - the maximum volume of oxygen that an individual's body is able to process and consume from the air inhaled; for comparative purposes, it is usually reported either in milliliters per kilogram of body weight per minute or in milliliters per kilogram of lean body weight per minute. (5)

CHAPTER II

REVIEW OF LITERATURE

Volumes of work have been done and are available concerning fitness and fitness testing. This information is reviewed here, in part, under the following two main categories: fitness and measurement of fitness. The section under fitness is further divided into a study of total fitness and the two aspects of physical fitness known as motor fitness and cardiorespiratory fitness. The second major section is separated into four areas of review: historical background, motor fitness testing, cardiorespiratory fitness testing, and comparisons of motor and cardiorespiratory measures.

FITNESS

Total Fitness

Probably no question in the field of physical education has been debated so often and with so little satisfaction as has, "What is fitness?" The Joint Committee of the American Medical Association and the American Association for Health, Physical Education, and Recreation issued a statement of definition which is, in part, included here:

> . . . fitness for effective living implies freedom from disease; enough strength, agility, endurance, and skill to meet the demands of daily living; sufficient reserves

> to withstand ordinary stresses without causing harmful strain; and mental development and emotional adjustment appropriate to the maturity of the individual. (46:433)

The fitness described here is fitness in its broadest terms, often called total fitness. Total fitness is perhaps the healthy individual in his fullest and completest measure. Barrow and McGee make the following statement concerning total fitness:

> For instance, this total concept of the individual is exemplified by the term 'fitness.' Much stress is placed on 'total fitness.' Total fitness is then broken down into several aspects, including physical, mental, social, and emotional. (2:112)

The components of total fitness, as set forth by the 1956 AAHPER Conference on Physical Fitness, are:

1. optimum organic health,
2. sufficient coordination, strength, and vitality to meet emergencies,
3. emotional stability to meet stress,
4. social consciousness and adaptability,
5. sufficient knowledge and insight to make suitable decisions,
6. attitudes, values and skills that stimulate participation in the full range of activity, and
7. spiritual and moral qualities that contribute the fullest measure of living. (19:8-9)

Morehouse and Miller place the components of total fitness into three major categories.

> Anatomical fitness implies possession of all the parts and organs of the body which are essential to the performance of the task . . . . Physiological fitness implies the capacity for skillful performance and rapid recovery. All activities require some degree of muscular strength, motor skill and endurance. The relative importance

> of one of these components in the performance of a particular task may determine a man's fitness for that task . . . . Psychological fitness for a task implies that the subject possesses the necessary emotional stability, drive or motivation, intelligence, and educability. (14:261)

Others recognize that total fitness is more than what is measured through the tools of physical fitness research. (3, 16) Oberteuffer and Ulrich offer suggestions as to what must be present in addition to the motor fitness components.

> To attain and maintain fitness, one must live the intelligent life, making constant adjustments to one's environment and accepting the responsibility of changing it when such change is needed. This means a rational program of activity, an adequate and balanced diet, ability to control psychological and physical stimuli and to resolve the resultant stress that they cause, prompt and competent medical care, and, of course, a sound philosophical basis for coping with contingencies for which no planning can be made. (16:91-92)

The totality of man is the one thing that must be considered in the connotation of total fitness. The integration of the facets of man that were once separated - physical, mental, social, emotional, and spiritual - make for the total man. A healthy state of the sum of these five facets could make for the totally fit man. In fact, it is doubtful that man can be separated from his wholeness. Nothing can happen to man that does not affect every fiber of his being. It would seem, conversely, that any measure of fitness would measure the so-called components of total fitness. It seems improbable to the writer that a person could measure well on the vigorous Twelve-Minute Test without indicating that his activities have been such that the other aspects of total fitness may also have been mirrored.

Physical Fitness

A more specific area of fitness deals with the physical fitness which is the type of fitness most people speak of in using the term. It is the fitness that involves physical education and medical disciplines to the greatest extent. "Generally, physical fitness denotes a quantitative and unspecified evaluation of the individual's physical state." (22:307)

> Physical fitness, while it is not so broad in its meaning as total fitness, would include adequate degrees of health, posture, physique, proper functioning of vital organs, nutrition, and good health habits, along with an adequate amount of endurance, strength, stamina, and flexibility. (2:125)

Gallagher and Brouha discuss three types of fitness that would fall within the area of physical fitness. The first is static or medical fitness which is "concerned with the soundness of the organs of the body." (43:834) Secondly, they label the fitness that "has to do with the efficiency of the body in strenuous work" (43:834) as functional or dynamic fitness. Lastly, and traditionally of most interest to the physical educator, they include motor skills fitness. This facet has to do with the "muscle coordination and strength in performing specific activities." (43:834)

Cooper places the classic facets of fitness into similar categories. The first he calls "passive fitness" or simply the absence of disease or physical disability. Of somewhat more value, if present in addition to an initial level of "passive fitness," is what he calls "muscular fitness." His third category is "overall fitness" or "endurance fitness" which goes beyond the

passive state and adequate muscular efficiency to include the efficiency of the vital organs. (5:8-9)

Paralleling Cooper very closely is the explanation by Cureton when he admonished that physical fitness goes beyond being able to pass a medical examination to include factors that would enable one to "handle the body well and . . . work hard over a long period of time without diminished efficiency." (6:18)

> In short, the fit person is one who is free of limiting and debilitating ailments, who has the stamina and skill to do the day's work, and who has sufficient reserve of energy not only to meet emergencies but to provide a zest for leisure time living. (17:277)

Several definitions have been quoted and are found in scores of books in the areas of physical education, medicine, physiology, and related disciplines. A final consensus to explain the term may be impossible. deVries (8) says that one must arbitrarily define physical fitness, yet it should be done using as background the work done in both physical education and medicine. He goes further to explain the work done by crediting physical education with developing test batteries of motor fitness which measure the following elements of physical fitness: strength, speed, agility, endurance, power, coordination, balance, flexibility, and body control. To medicine he attributes the concept of physical working capacity which is measured objectively by oxygen consumption. (8) The two of these, motor fitness and cardiorespiratory fitness, are reviewed in the following two sections under separate headings. They are the two types of fitness with which this study concerns itself.

Motor Fitness

This area of fitness

> indicates that the primary concern is for big-muscle movements and static positions dominated by muscular energy, kinesthetic sense, and the suppleness of the major tissues and joints rather than for highly refined, skilled movements. (35:57)

Cureton continues his description of motor fitness with an explanation of the six components which he considers comprise it.

> Balance emphasizes mental control and poise (with and without sight), the kinesthetic sense of position, and the various anatomical and physiological capacities which regulate acts of balance.
>
> Flexibility emphasizes the capacity of the body to move easily to the full range of joint extension and flexion without undue restrictions in the joints and tissues.
>
> Agility emphasizes the capacity for fast reaction in controlled movement where accuracy is also a feature, and the ability to handle the body quickly and precisely, not necessarily with maximum force or power.
>
> Strength emphasizes the capacity of the body, hands or legs to exert great force.
>
> Power emphasizes the capacity to release great explosive force to execute fast or sudden efforts which move the entire body with maximum effort.
>
> Endurance emphasizes the capacity for continuous exertion with partial recovery during the exercise. (35:57-58)

"Motor fitness might be referred to as efficient performance . . . ," (12:95) and it is gauged by this criterion. It is the "aspect that most fitness tests actually measure." (2:125) However,

> physical performance is an integration of neuromuscular (motor fitness), organic (cardiovascular respiratory

> fitness), and physique (bone, muscle, and fat measures) components. (72:6)

Though motor tests may be used, the result may be some kind of picture of the total man and his total fitness.

Cardiorespiratory Fitness

The area of fitness which is of greatest interest to physiologists and medical personnel is that which affects the vital organs of the circulatory and respiratory systems. Sometimes called organic fitness, this type of fitness is herein referred to as cardiorespiratory fitness. Cooper, in his work, follows the policy of using the term physical fitness to mean "only cardiovascular-pulmonary fitness; that is, a good heart, good blood vessels, and good lungs." (30:22) The reason he gives for using the term in this more specific way is that "This type of fitness is the most important, for a person's life depends upon these organs." (30:22)

Cureton, using the term interchangeably with cardiovascular fitness says that it

> describes the capacity, endurance and efficiency of your circulatory system--or the ability of your bloodstream to transport oxygen from the alveoli of your lungs to the muscle cells of your body. (7:49)

The state of this fitness is indicated, ordinarily and most satisfactorily, by means of laboratory techniques which require strenuous work yet no special skill. Indicators commonly used are rate of oxygen debt, post-exercise blood pressure, electrocardiograms, heartographs, ballistocardiograms, step tests, pulse rate, force of heart beat, minute volume, etc. Most

investigators, however, express greatest satisfaction with a measure of aerobic capacity or the maximum oxygen intake. (5, 22, 55) The most often used assessments of the maximum oxygen intake in recent years have been by means of variations of treadmill, bicycle ergometer, or step tests.

MEASUREMENT OF FITNESS

Historical Background

The requirements of a good test are generally conceded to be validity, reliability, objectivity, and simplicity. (13) Especially to be considered in fitness testing are the amount of time involved, the difficulty, the motivation, safety factors, and making certain that the test is appropriate to the objective of the tester. (17)

"Every objective held valid by the teacher requires some evaluation of results." (17:278) Through the years physical fitness has been considered a responsibility of the physical educator; (17, 30) consequently, he must be responsible for measuring it by means of scientifically sound tools.

Since the late nineteenth century, there have been numerous efforts to define and measure fitness. Cureton (6) traces these efforts through the early years of this century. The period from about 1884-1905 consisted largely of evaluation by means of anthropometric and dynamometer strength tests. Names connected with these early strength tests include Sargent, who developed a

competitive strength test used among fifteen major universities and Kellogg, who developed the "universal Dynamometer" test.

Strength testing continued to be the major emphasis into the twentieth century. In 1913 Sargent reviewed twenty years of efficiency testing and declared that strength "seemed the most common factor required in all forms of physical activity." (51:453) Shortly after that Martin undertook the development of "resistance strength tests."

Cureton stated further that, at about the same time Meylan "introduced a fairly comprehensive appraisal of the students at Columbia University." (6:31) Also during the late teens critical evaluation of functional tests, especially of the heart, were being studied in England. According to Cureton, these measures involved various pulse rate counts. Some of these are included among the tests of cardiovascular function listed in the Appendix of this paper.

In 1922, Burton and Opitz pointed out that the trend was shifting from tests measuring "big muscle development" to those of cardiorespiratory efficiency and, in 1924, Collins and Howe were doing research at Wellesley about which Cureton says, "endurance came forward from the Wellesley research studies as the most desirable emphasis in physical fitness." (6:36) However, in 1925, Rogers developed one of the most widely known and used strength tests, the Physical Fitness Index or P. F. I., which indicated the continuing influence of strength tests.

Despite all that had been done in the area of fitness testing, Scott and French point out that "the answer on how to measure

fitness was not available in the early 40's when the problem of testing fitness suddenly took on new importance." (17:278) Everyone was fond of a particular test which seemed to measure what he was after and there was neither uniformity nor agreement on the best measure available. (17)

It was about this time that the classic work of Cureton was being carried on at the University of Illinois. Perhaps no one has contributed more to fitness testing, especially in the field of motor fitness, than he. He studied numerous variables and determined their validity and reliability coefficients according to professed objectives. (6)

The physical fitness emphasis gained much impetus when the statistics of the Selective Service indicated a great number of military-age men were being rejected due to physical condition. Much work was begun during and after the war years to determine a criterion against which to measure an individual's fitness and to develop programs to improve his condition.

The great surge of interest, however, resulted from the shock of the results of the Kraus-Weber tests of minimum muscular fitness in 1953. The testing had compared American children to those in Switzerland, Austria, and Italy and showed them to be woefully deficient in strength and flexibility. Whatever the value of the test itself, it served to stir national concern. President Eisenhower created the Council on Youth Fitness at the cabinet level and then a Citizen's Advisory Committee to investigate what course of action should be taken.

In 1956, the AAHPER held a conference on physical fitness and a committee was delegated to review many tests of fitness currently in use. When none was found suitable, the committee developed its own, the AAHPER Youth Fitness Test, in 1957. This is the same seven-item battery used in this study except that the bent-arm hang has since been substituted for the pull-up for women. The other six items include sit-up, shuttle-run, standing broad jump, softball throw for distance, 50-yard dash, and the 600-yard run-walk. National norms are available on all items, except the bent-arm hang, for boys and girls from ages five through college.

Motor Fitness Testing

> Many excellent tests of motor fitness have been devised. The elements of motor fitness are so many, however, and some are so difficult to define, that each motor performance test battery must be considered a compromise between the ideal of measuring all identifiable elements and the practical need to choose a number of representative elements, which allows measurement in reasonable amounts of time. (8:213)

Cureton, Welser, and Huffman indicate that the difficulty inherent in constructing a short motor fitness test includes the omission of some types of items and thus of measurement of certain aspects of motor fitness, the lower validity and poorer reliability due to fewer items, the required use of statistical procedures which are less accurate, and the great difference of opinion as to what should be measured. (36)

With all the limitations involved in motor fitness testing, "muscular fitness tests should be a part of every school

health examination." (47:19) The inherent value of this type test has brought about numerous versions of tests to measure motor fitness on the part of various individuals and numerous organizations. For the purpose of this study there has been no detailed review presented of the numerous tests of motor fitness that are available. Those currently in use are of four major types. They fall into batteries constructed by the military for use in their conditioning programs, tests advocated by certain state departments of education for their own curricula, tests constructed by individuals for various uses, and those constructed by organizations. A partial list of these tests may be found in the Appendix. A more detailed review of information concerning the test selected to represent this type of testing in this study follows.

Marmis, et.al. (49) reported that 25,000,000 American children have been tested by the AAHPER Youth Fitness Test Battery since its construction in 1957. This test is recommended by the President's Council on Physical Fitness as well as the AAHPER. According to Olree

> The test is probably the most widely used method of assessing physical fitness and of evaluating the effectiveness of programs designed to develop physical fitness in use today. (56:67)

Because it is so widely used (49, 56, 72) and has been shown by research to be quite sound, (40, 56, 72) it was chosen as the representative of motor fitness tests to be used in this study.

The test, a practical test for use in assessing fitness in schools across the nation, consists of a seven-item battery.

The pull-up has been replaced by the bent-arm hang for women and the women are limited to a maximum of fifty sit-ups. Other than that, the battery is the same for both boys and girls of all ages. The other items included are a shuttle-run, 50-yard dash, 600-yard run-walk, standing broad jump, and softball throw for distance. Two sets of norms are available on a national population. First compiled in 1958 and then updated in 1965, they are reported by age or by the Neilson-Cozens Classification Index.

The test is an indicator of present status of fitness in the following areas: arm and shoulder strength by means of the bent-arm hang; abdominal strength by means of the sit-up; endurance by means of the sit-up and 600-yard run-walk; speed by means of the shuttle-run and the 50-yard dash; agility by means of the shuttle-run; power by means of the standing broad jump; and arm and shoulder coordination by means of the softball throw for distance. (2)

Ponthieux and Barker (58), from a factor analysis of the items on the test as administered to college men, isolated the following three factors in the AAHPER battery: circulorespiratory endurance most clearly represented by its loading on pull-ups, sit-ups, and 600-yard run-walk; gross body coordination represented by the softball throw for distance; and muscular explosiveness, which was most well represented by the shuttle-run, broad jump, and the 50-yard dash.

Sparks (79) developed a modified version of the AAHPER test for use in United States dependent schools where facilities

are at a minimum. He attempted to retain the elements of fitness measured by the AAHPER battery. Two of the items included were the sit-up and the standing broad jump as found in the AAHPER test. These were accepted at face validity. He also included a desk pull-up which he validated against the AAHPER pull-up and a figure eight run validated against the three running items in the original test. The coordination element was eliminated by the loss of the softball throw without a replacement item. The items were found to be valid against their stated criteria and reliable by means of the test-retest method.

Rothermel, Pollock, and Cureton (59) administered the AAHPER battery to eighty-seven boys between the ages of seven and thirteen before and after the boys spent eight weeks at the University of Illinois Sports-Fitness Summer Day School for Boys. The experimental group showed significant changes in the following items: standing broad jump, sit-ups, pull-ups, and 600-yard run-walk. All of these items purport to measure muscular strength and endurance, power and cardiorespiratory endurance. No changes were apparent in the items purported to measure speed, agility, and coordination. No significant differences were noted in the control group.

To determine whether the multiple-trial test items were being administered effectively, Marmis, et. al. (49) administered the battery to 2,060 children (938 girls and 1,122 boys). From their study they recommended that: two trials are sufficient for the standing broad jump, at least three are necessary in the

shuttle-run, two are necessary in the 50-yard dash, and two are sufficient in the softball throw.

Several individual items in the battery have caused some criticism and concern. The flexed-arm hang is one of them.

> Arm strength has traditionally been measured by pull-ups. While this is satisfactory for men, it has not been a discriminating item for women because so many lack sufficient strength to complete one pull-up. In an effort to provide a better measure, the modified pull-up has been substituted in test batteries for women.
>
> In 1965, the AAHPER replaced this item by the flexed-arm hang (bar hang) . . . . (32:415)

Still dissatisfied with this, Cotten and Marwitz (32) undertook to determine whether a modification of the flexed-arm hang would be more valid and easier to administer. They used fourteen women majoring in physical education. The modification consisted in stopping the watch when the angle at the elbow became greater than 90 degrees rather than as described in the AAHPER Youth Fitness Test Manual. They found that there was a relationship of $r = .93$ between the pull-up and the modified hang. The regulation hang related to the pull-up with an r of .73 indicating a closer relationship between their modification and the pull-up. A possible explanation is that the modified hang allows movement through approximately the same range of motion as the pull-up.

Cotten and Chambers (31), seeking to have the softball throw for distance measure explosive strength and eliminate coordination and skill as factors, administered three different throws to 100

male college students. The three methods used were side throw as described in the test manual, a feet-in-place throw, and a knee-in-place throw from a kneeling position. The intercorrelation would indicate that any of the three could be used to measure explosive strength. The investigators recommended the knees-in-place throw due to the time and ease of administration and the small amount of space required.

Because the test allows the use of either a track, a football field, or a 50 x 50 yard square in the administration of the 600-yard run-walk, Cotten and Singh (33) investigated to determine whether the means for the times would significantly differ when the tests were administered in these different locations. The manual does not explain which area was used in determining norms. Since there appears to be a direct relationship between the number of corners involved and the length of time needed to complete the test, the norms would appear to be inaccurate. However, since intercorrelations between scores obtained from the three areas were quite high, the three types of field areas are probably equally good for administering the 600-yard run-walk.

Cardiorespiratory Fitness Testing

For reasons which will be discussed in greater detail later in this paper, physical educators have found cardiorespiratory testing difficult to carry out. However, this type of fitness testing is preferred by physiologists and one of the pioneers in this type of testing explains why.

> Physiology then showed that physical exertion overtaxes the circulatory mechanism long before it exhausts the skeletal musculature . . . . Hence to-day (sic) the general opinion is that strength tests do not permit us to draw satisfactory conclusions regarding the efficiency of the entire body . . . . The fitness that the world at large is most interested in is that of being in condition to do the day's job without experiencing unhealthy fatigue and in being in condition to enjoy life to a good old age . . . best definition of fitness is found in our understanding of a normal-load, the crest-load and an overload. (62:405-406)

The measurement of efficient organic function of systems as complex as the cardiovascular and respiratory would seem a tremendous undertaking were it not that "syndromic reaction to exercise in terms of cardiorespiratory function make it possible to measure a single factor . . . ." (16:94) Most investigators interested in fitness testing today would agree that the maximum oxygen uptake is "the ultimate criterion of physical fitness." (40:192)

With all the support for this criterion of physical fitness, a note of caution should be sounded.

> One disadvantage of the use of this measure, however, in general fitness programs is that it requires specialized equipment and knowledges . . . . Another disadvantage is the time consumed in the application of the techniques. (40:193)

The workload for determining the physical working capacity, which is dependent on the capacity of the system to supply oxygen to the muscles, is usually provided by a treadmill, a bicycle ergometer, or bench stepping. Other methods have been used and some of the more often used ones are listed in the Appendix. They fall under obvious categories of treadmill, bicycle, and step tests as well as several usable non-performance measures.

Cooper points out that

> It was not until the ergometer and treadmill were combined with oxygen-measuring equipment that these final difficulties were overcome. Tension can make your heart beat faster, but it has practically no effect on oxygen consumption. (5:29)

He uses the treadmill almost exclusively because maximum performance on the ergometer requires unusual leg power which most people lack.

The measure of maximum oxygen consumption probably evaluates cardiovascular fitness, respiratory function, muscular efficiency, strength, muscular endurance, and obesity. (8) If this is true it is probably the single most comprehensive item which has been used to evaluate physical fitness.

Although deVries points out that physical educators generally lack the ability to perform the analyses necessary, lack the facilities, and have classes too large to make it feasible, he expresses the need for wider use of this concept in the physical education profession. It would, he feels, unify thought between the profession and the medical profession and provide motivation for less skilled students to compete successfully with their peers. (8)

In opposition to this point of view, Cureton points out that

> The physiologists' view of 'physical ability' has always been inadequate to the physical educator, who is interested in the many specific abilities rather than in general working capacity alone. (35:7)

Due to the difficulties inherent in measuring the maximum oxygen intake, many methods have been tried to predict maximum intake by other than maximal laboratory techniques. Most of the attempts have been made by some methods using heart rate at submaximal loads. The predictive measures which have been used

include the PWC-170 test (8), the Astrand-Rhyming Nomogram (23), the Harvard Step Test (26), as well as other efforts by individuals such as deVries and Klafs (38); Issekutz, Birkhead, and Rodahl (45); and Falls, Ismail, and MacLeod. (40) There is some validity in these methods of prediction. (24, 25, 38, 44)

deVries and Klafs (38) evaluated some of the more common submaximal tests of maximum oxygen intake against a criterion measured by the bicycle ergometer. Of the tests used (Sjostrand-Wahlund, a modification of the Sjostrand-Wahlund using bench stepping, Harvard Step Test, Progressive Pulse-Ratio Test, a three minute modification of the Delta R. W. Test, and the Astrand-Rhyming Nomogram) the highest predictive values were evidenced by the Astrand-Rhyming Nomogram and the Sjostrand Test. They concluded that

> it would seem that at least for active college age men, maximal O_2 intake and consequently physical working capacity can be predicted with a reasonable error of predication from submaximal tests. (38:213-14)

Glassford and associates (44) administered three direct tests of oxygen intake (Mitchell, Sproule, Chapman Treadmill Test; Taylor, Buskirk, and Henschel Treadmill Test; and the Astrand Bicycle Ergometer Test), one indirect measure (Astrand-Rhyming Nomogram), and the Johnson, Brouha, Darling Physical Fitness Test to twenty-four subjects of ages 17-33. Correlation coefficients between various oxygen uptake tests as well as the fitness test were all found to be significant. They ranged from .62-.83. None was significantly greater than any other. It would seem from their research "that the relationship between the nomogram

values and any one set of values determined by a direct technique is as good as the relationship between the values of any two direct measures employed in this study." (44:512) Further,

> statistical analysis of the correlation coefficients between the fitness test and the four oxygen uptake tests indicated that the indirect test was as highly correlated with such a measure as were the three direct tests. (44:512)

Taylor, Buskirk, and Henschel (68), using a treadmill and varying its grade rather than speed, attempted to describe the technique of maximal oxygen intake used in their laboratory, the limitations of measuring maximum oxygen intake, and the usefulness in longitudinal experiments. Their test had a reliability of .95. A light meal had no effect on the maximum intake. However, the following factors were shown to affect it: room temperature, time of warm-up, and increasing working muscle mass by simultaneously running and arm work. They concluded that maximum oxygen intake is only maximum for specified working conditions.

Astrand (22) has investigated the effect that sex and age have in human physical fitness. Age apparently brings a decrease in maximum oxygen capacity. Astrand found that the average maximal oxygen intake for forty-two men was 4.11 l/min. and for forty-four women was 2.90 l/min. or 29 per cent lower. He cites another investigation in which eighteen women and seventeen men students were tested on the bicycle ergometer with the average oxygen intake for women equal to 36.0 ml/kg/min. and that for men equal to 51.0 mil/kg/min.

deVries (21) discussed Astrand's work published in certain Scandinavian journals. He reports norms for women in relation to age and oxygen consumption. Table I shows some of the equivalences in the age group nearest to the one which participated in the present study.

TABLE I

NORMS FOR MAXIMUM O_2 CONSUMPTION (AEROBIC WORKING CAPACITY) IN WOMEN AGE 20-29 (8:211)

Category	Maximum O_2 Consumption in ml of O_2 per kg of Body Weight
Low	28
Fair	29-30
Average	35-43
Good	44-48
High	49+

Michael and Horvath (53) working with thirty women subjects between seventeen and twenty-two years attempted to ascertain the physical working capacity. Although they stated that "predication of maximal work capacity could not be made for individuals from any single submaximal measurement"(53:263), they offer some of the rare data on oxygen uptake levels in college women. According to the varied workload, the mean oxygen uptake in ml/kg/min. at standard conditions ranged from 23.3 to 30.4.

Metheny, et.al. (51) made a comparative study of some physiologic responses of men and women to strenuous exercise. Although other aspects were measured, only that related to the oxygen consumption is reported here. Following moderate exercise, there was no marked difference between the subjects who were of ages ranging

from 20-27 for the women and 19-23 for the men. The women consumed 27.8 ml/kg/min. while the men consumed 29.6 ml/kg/min. Following a rather strenuous run the men consumed a markedly greater amount, 51.3 to 40.9 ml/kg/min. for the women.

The data reported above represent some of the limited information available concerning women and their maximal oxygen intake. Other studies are being undertaken. (71) Other authors, of course, have been concerned with the circulorespiratory fitness of women and some of their work is cited in the following paragraphs.

Skubic and Hodgkins (65) modified the Harvard Step Test for use with women and found it to be both reliable and valid. In addition they found that it clearly differentiated among women who were highly conditioned, only moderately active, and sedentary.

Clarke (28), also using a modification of a step test for college women, found women taking swimming showed greater improvement than did those taking field hockey, crew, tennis, dance, volleyball, or archery.

Another test in the long list of measures of cardiovascular fitness and, specifically a predictive test for the maximal oxygen intake, was devised by Cooper. (29) Due to the problem of determining this capacity for large groups, Cooper studied Balke's work in which he had related various run-walk tests to oxygen consumption, either by measuring distance covered in a given time or by measuring time required to run a given distance. One hundred and fifteen Air Force personnel were evaluated for oxygen consumption on both a treadmill test and a twelve-minute field

performance test. The two were found to be correlated highly (r = .897). Since that time more than 5,000 additional men have been evaluated.

> The significance of this relationship makes it possible to estimate with considerable accuracy the maximal oxygen consumption from only the results of the 12-minute performance test. (29:201)

It would also appear that the Twelve-Minute Test is an objective measure of physical fitness reflecting cardiorespiratory function. The test is of great interest and import to the physical educator due to the accuracy, ease of administration, and requirement of no special equipment.

As a result of Cooper's work, levels have been established for the twelve-minute walk-run test in relation to cardiovascular fitness. These equivalences are shown in Table II.

The above information has been included in a classification chart showing levels or categories of fitness according to the distance covered in the Twelve-Minute Test and the oxygen consumption equivalences. The chart can be found in Table III. This standard has been set for men. These are not norms from a given population but rather a standard for which to strive.

Cooper established 42.6 ml/kg/min. for a good level of circulorespiratory fitness, as shown in the chart, following studies of the work of Astrand, Balke, and others. Note that this is indicated by a twelve-minute run covering 1.5 miles.

There has been some criticism of Cooper's failure to adjust his system for sex and age and of the fact that the test ends with

TABLE II

PREDICTED MAXIMAL OXYGEN CONSUMPTION ON THE BASIS OF 12-MINUTE PERFORMANCE

Distance (Miles)	Laps (¼ Mile Track)	Maximal Oxygen Consumption (ml/kg/min)
1.0	4	25.0*
1.000	4	25.0*
1.030	-	26.0*
1.065	4¼	27.0*
1.090	-	28.2
1.125	4½	29.0
1.150	-	30.2
1.187	4 3/4	31.6
1.220	-	32.8
1.250	5	33.8
1.280	-	34.8
1.317	5¼	36.2
1.340	-	37.0
1.375	5½	38.2
1.400	-	39.2
1.437	5 3/4	40.4
1.470	-	41.6
1.500	6	42.6
1.530	-	43.8
1.565	6¼	45.0
1.590	-	46.0
1.625	6½	47.2
1.650	-	48.0
1.687	6 3/4	49.2
1.720	-	50.2
1.750	7	51.6
1.780	-	52.6
1.817	7¼	53.8
1.840	-	54.8
1.875	7½	56.0
1.900	-	57.0
1.937	7 3/4	58.2
1.970	-	59.2
2.000	8	60.2

(29:203)

*Insufficient data at these distances to make reliable comparisons.

TABLE III

LEVELS OF CARDIOVASCULAR FITNESS BASED ON 12-MINUTE PERFORMANCE AND MAXIMAL OXYGEN CONSUMPTION

Distance (Miles)	Maximal Oxygen Consumption (ml/kg/min)	Fitness Level
<1.0	<25.0	Very poor
1.0 to 1.24	25.0-33.7	Poor
1.25 to 1.49	33.8-42.5	Fair
1.50 to 1.74	42.6-51.5	Good
1.75 or more	51.6 or more	Excellent

(29:203)

subjects stopping at various spots around the course. He has undertaken to remedy this and in the next publication of his book plans the following modification, according to Pollock. (57)

1. An age factor will be incorporated in the evaluation and training processes.
2. The 12-minute test will become a 1.5 mile test. The predictive value is identical, but the administration begins and ends at the same point. (57:5)

Cooper says there are no appreciable data for women. He is in the process of collecting such data and they should be available in the revised edition of Aerobics. He did test one group of 266 airman WAFS with a mean age of 18.6 years. He concluded from this that there would be considerable difficulty using the same performance levels for females. (71)

Cooper referred the writer to work done by Arnold on college age women in California. Cox (73) writing in response to inquiry, stated that, at Cooper's suggestion, their girls ran a timed 1.3 mile rather than the Twelve-Minute Test. The mean time was 12 minutes and 9 seconds. This testing was done on women between ages 17-21. Following the results of their testing, Cooper suggested that the women's distance probably should be altered to 1.25 miles to enable comparison with the Twelve-Minute Test categories established for men.

Dominic (74) used a bicycle ergometer test of maximum oxygen intake to validate the test for junior high school girls and a test-retest method to check reliability. She found the test to be reliable (.89) and valid (.619 for the first test and .667 for the best test) and superior to a run of either five or ten minutes in discriminating cardiorespiratory fitness as measured by the criterion. She concluded, however, that

> if the twelve minute tests were given to both boys and girls the scoring scale would need to be adjusted for the sex and age involved. (74:37)

Cooper states that a 13:30 minute requirement for a 1.5 mile distance appears to be realistic for girls of junior high school age. (30)

Dolittle and Bigbee (39) tested 153 boys of junior high school age and found that the test was both reliable (.94) and valid (.90) using a bicycle ergometer test of maximum oxygen intake as the criterion. Cooper agrees that, for this age group, the standard is the same as for adult men. (30)

Motor Fitness and Cardiorespiratory Fitness Comparisons

Of great pertinence to the current study are research studies in which there is a comparison of fitness represented by profiles of motor fitness and cardiorespiratory fitness. In one of the earliest of these studies, Scott, Mordy and Wilson (63) attempted to validate a physical test, used with large groups, against a test of work capacity. Although "the value of performance tests as measures of improvement and as motivating factors" (63:129) was recognized by the investigators, they were interested in testing its validity against a quantitative measure of work capacity. Using college women as subjects, they administered the Iowa Physical Fitness Battery and a bicycle ergometer test. The Iowa Battery consisted of sit-ups, chair-stepping, vertical pull, obstacle run, and bounce. The work capacity was "the total work output of the individual as measured in kilogram-meters for a two-minute period at maximum speed on the bicycle ergometer." (63:129) Zero-order correlations of the test items were computed with the work capacity criterion and were as follows:

1. obstacle run .529,
2. vertical pull .489,
3. total sit-ups in fifty seconds .482
4. bounce .448,
5. total chair stepping in forty-five seconds .402,
6. total chair-stepping in fifty seconds .372,
7. chair-stepping ratio .372,
8. sit-up ratio .351.

A definite relationship seemed to exist between each item and the capacity of each individual to do work. All correlations were significant, for the eighty-two subjects, at the .01 level of confidence. They concluded that no single item had high enough relationship to be used alone to measure capacity to do work, yet each showed a significant relationship that would appear to indicate that each measured a part of the total picture of fitness.

Doolittle and Bigbee (39) sought to evaluate the Twelve-Minute Test as an indicator of cardiorespiratory fitness, and to compare it to the AAHPER 600-yard run-walk. They tested 153 ninth grade boys and found the test to be both highly reliable (.94) and valid (.90) when measured against a criterion of a maximum oxygen intake test on a bicycle ergometer test. It was more valid as measured against the stated criterion than was the 600-yard run-walk which correlated only .62. These investigators administered the test on a quarter-mile grass track as was done in the present study.

Dominic (74) also attempted to compare the Twelve-Minute Test to the 600-yard run-walk. Her work was done with junior high school girls, yet her results were comparable to those of Doolittle and Bigbee. The reliability coefficient was .89 and the validity was .667. She also measured against a test using the bicycle ergometer. She did, however, recognize that the test categories were difficult to use for the junior high school aged girl.

Olree and associates (56) evaluated the AAHPER test against the Balke treadmill test using seventy-six boys of ages sixteen

and seventeen. Their purpose was two-fold: to evaluate the test's validity as a physical fitness measure and to determine the nature and extent of the relationship between the percentile scores on the AAHPER test and some objective, generally accepted, physiological measure of physical fitness. These investigators found "a significant, positive relationship, at the .05 level, between each of the AAHPER test items and the maximal oxygen uptake per kilogram of body weight per minute." (56:70) The correlation coefficients found are as follows:

1. pull-up .293
2. 50-yard dash .480
3. softball throw .430
4. shuttle run .374
5. sit-ups .226
6. standing broad jump .444
7. 600-yard run-walk .532

Corroll (72) also compared the AAHPER items to maximum oxygen intake as measured by the Mitchell, Sproule, and Chapman Treadmill Test. These tests were administered to 119 eleven year old boys. The purpose of this study "was to determine the relationship between the motor performance items of the AAHPER Youth Fitness Test and organic (maximal oxygen intake) efficiency." (72:2) Correlations were found from raw data as follows:

1. height .139
2. weight .543
3. pull-ups .454

4. sit-ups .308
5. shuttle run .543
6. standing broad jump .536
7. 50-yard dash .557
8. softball throw .313
9. 600-yard run-walk .689

Falls, Ismail, and MacLeod (40) attempted to determine the validity of the AAHPER battery as a predictor of maximum oxygen uptake in adults. They used eighty-seven university faculty and staff men over an age range of 23-58 years. These men had participated in a five-month fitness program. They compared the motor items to three measures of maximum oxygen intake: gross oxygen uptake, oxygen uptake per kilogram of body weight, and oxygen uptake per kilogram of lean body weight. The multiple correlation using the seven fitness test items was higher (.760) with the second measure. The correlations between the second measure and the items were as follows:

1. pull-ups .4777
2. sit-ups .4036
3. standing broad jump .4667
4. 50-yard dash .4832
5. shuttle run .6145
6. medicine ball put .1075
   (substitute for
   softball throw)
7. 600-yard walk-run .6443

Their conclusions are all pertinent to this study and thus are included here.

1. Maximum O_2 uptake/kg body weight as measured in this study can be estimated with reasonable validity from the motor fitness items contained in the AAHPER Youth Fitness Test . . . .
2. Since the maximum O_2 uptake/kg body weight is considered by many to be the ultimate criterion of physical fitness, this study helps to validate the Youth Fitness Test . . . .
3. The best single estimator of maximum O_2 uptake among the Youth Fitness items is 600-yard run-walk.
4. For the population studied, optimally-weighted Youth Fitness Test items appear to be about as good in estimation of maximum oxygen intake/kg body weight as the more specialized methods that have been reported in the literature. (40:200)

CHAPTER III

PROCEDURE

SELECTION OF TESTS

AAHPER Youth Fitness Test

This is the most widely used motor fitness test battery today and was selected as one measure of fitness for this study. Should it be highly correlated to the cardiorespiratory measure, many might prefer to substitute the shorter Twelve-Minute Test.

The test has been compared by various investigators against other motor fitness tests. (72) It has been compared with measures of cardiorespiratory fitness.(40, 56, 72) The overall picture presented by the AAHPER test when studied by these people is that it is one of the better measures of motor fitness available. It also seems to have relative efficiency of administration. The administration of the test follows the instructions found in the manual. (1) The materials needed are minimal and, when carefully planned and large numbers of administrative personnel are available, rather large numbers can be handled in convenient blocks of time.

The AAHPER battery consists of seven items purported to measure various aspects of motor fitness. The items advocated for women are the bent-arm hang, 50-yard dash, softball throw for distance, shuttle run, sit-ups, standing broad jump, and the

600-yard run-walk. These items are supposed to measure arm and shoulder strength, abdominal strength, endurance, speed, agility, and arm and shoulder coordination. Subjects are given multiple trials with the shuttle run, standing broad jump, and the softball throw. The results of the first attempt are recorded for the remaining four items. No provision is made for totaling the score as a measure of total motor fitness.

Twelve-Minute Test

The Twelve-Minute Test was used as the indirect measure or estimate of cardiorespiratory fitness. Cooper has validated this test against a laboratory test of maximum oxygen intake measured while running on a treadmill. The test, unlike most other field tests, is a measure of distance covered during a given time rather than time required to cover a given distance. Cooper contends that this distance may be translated into milliliters of oxygen. The information that is available up to the present from Cooper involves data on men only. The following distances for men are translated into milliliters of oxygen:

TABLE IV

TWELVE-MINUTE TEST DISTANCES TRANSLATED INTO MILLILITERS OF OXYGEN (29)

Distance	ml. per kg. per minute
less than 1.0 mile	less than 25
1.0 - 1.24 miles	15.0 - 33.7
1.25 - 1.49 miles	33.8 - 42.5
1.50 - 1.74 miles	42.6 - 51.5
1.75 or more	51.6 or above

These distances probably will not hold true for women. The test itself, however, was considered a valid measure of cardio-respiratory fitness in women, whether or not the oxygen uptake volumes were equivalent to those for men. (73, 74) It now appears that a woman covering a distance of 1.25 to 1.3 miles might be in comparable condition to a man running a 1.5 mile in the same twelve-minute period. (73)

The test, as administered by Cooper and his staff, is simple. Using a stop watch and whistle or gun, the administrator signals at the beginning of the test and again at the end. The individual being tested is responsible for checking his own distance and reporting it to the recorder. The test is run around an oval track marked off in tenths of miles. Cooper instructs the group being tested to run as much as possible, then walk until able to run again, and continue to alternate. Obviously, large groups can be accommodated at a single test session.

SELECTION OF SUBJECTS

The women students at The University of North Carolina at Greensboro who were majoring in physical education were contacted by class. The faculty members in the Department of Health, Physical Education, and Recreation had approved the testing and had agreed to make the AAHPER test a departmental test. Taking the Twelve-Minute Test was to be purely voluntary. This was explained to each of the four classes and cooperation was encouraged. No one was pressured in any way to participate. Of the approximate

110 persons contacted, sixty-three women physical education majors agreed to take the Twelve-Minute Test in addition to the AAHPER test.

Dr. M. E. Rice of the University Health Service stated that no additional physical examination would be necessary since the University requires one for each student. Each student was given an information sheet about the tests and a form to complete and return stating his intention about participating in the Twelve-Minute Test. A copy may be seen in Appendix C.

ADMINISTRATION OF THE TESTS

AAHPER Youth Fitness Test

The motor fitness battery of the AAHPER was administered at 11:00 a.m. on Thursday, April 17, 1969. This was a time when it was possible to obtain maximum student participation as well as cooperation from the faculty and graduate students in administering it. The students were asked to report to the athletic field, dressed for activity, promptly at 11:00 a.m. There were seven test areas and eighteen test stations utilized. A diagram of the field and the tests stations may be found in Appendix C.

A table containing the individual scorecards was located at the entrance to the field. (A copy of the scorecard is reproduced in Appendix C.) Also at the table was a person in charge of traffic flow who sent the students to one of six test areas around the field. The students were instructed to move counter-clockwise around the field and to conclude with the 600-yard walk-run.

Each station was manned by personnel qualified by virtue of experience and/or briefing sessions prior to the test session. Each person was given individual instructions, both in written form and through conversation with the writer. They were members of the faculty of the Department of Health, Physical Education, and Recreation at The University of North Carolina at Greensboro, graduate students, and a few undergraduate students. These persons also served as recorders. The Appendix includes a list of the personnel who helped administer the tests. The items were administered according to instructions taken from the AAHPER Youth Fitness Test Manual. They are included in the Appendix.

Seventy-eight women students took the test during the hour. Three men students were tested but their scores were not used in this study.

Twelve-Minute Test

The administration of the Twelve-Minute Test was originally scheduled for three testing sessions. They were on Monday, April 14, Tuesday, April 15 and Wednesday, April 16, at 5:00 p.m. This time was selected because it was the only time of the day when large numbers of students were free. Since this was mealtime, the students were asked not to eat prior to the test.

The students who had agreed to be tested in the Twelve-Minute Test had signed a paper indicating their preference of test dates. Twenty-one signed for Monday, twenty-four for Tuesday, and eighteen indicated a preference for Wednesday. Each of the sixty-three received a reminder just prior to the day she was to be

tested. They were told to report at remaining sessions in case of rain.

On April 14, the weather was cool and there had been rain during the day. Only seven of the students came for the test. On April 15, the session was completely rained out. There was a break in the weather on Wednesday and, although conditions were not ideal, eighteen were tested on April 16. Those who had not taken the test were contacted and asked to come to special sessions at the same time the following Monday or Tuesday. On Monday, April 21, thirteen were tested and Tuesday, April 22, the remaining nine took the test, making a total of forty-seven.

The grass track around the playing fields area at The University of North Carolina at Greensboro was used for administering the Twelve-Minute Test. It is a quarter-mile track. Rather than using one-tenth mile divisions, the track was divided into ten equal distances equivalent to .025 of a mile each. This gave a more precise measure of distance covered. Otherwise, the test was administered as described by Cooper in Aerobics. (5) A brief set of instructions may be found in the Appendix.

The students had been asked to wear loose clothing and tennis shoes. They were given the following instructions: begin running at the sound of the gun; run at a pace you think you can maintain for twelve minutes; when you cannot run farther, walk until you can run again; and keep moving until the starter's gun fires the second time. They were also told that, when the test ended, they were to take note of the flag marker they had just passed.

These flags marked one-fortieth of a mile. On the quarter-mile track, there were ten markers with letters from A-J. They were told to report this letter and the number of the lap last completed to the recorder who converted the lap and letter into distance in miles using the conversion table found in the Appendix. Each participant was advised to warm-up briefly before the test and to continue moving following it until they had cooled off. There was no uniformity to the warm-up. Most students did a few stretches or wind sprints.

TREATMENT OF DATA

National norms for the AAHPER Youth Fitness Test are available on college women. They are not available for women majoring in physical education nor on the new bent-arm hang item. Therefore, T-score norms were established for women majoring in physical education at The University of North Carolina at Greensboro from 146 students who had taken the AAHPER battery from 1966 to 1969.

The Pearson r was used to find the following relationships:

1. The score in miles on the Twelve-Minute Test and the T-score total of the AAHPER test,
2. the raw score on each item of the AAHPER test and the Twelve-Minute distance,
3. the raw score of individual items and the total T-score of the AAHPER test, and

4. the T-score totals on the AAHPER test and the fitness level categories of the Twelve-Minute Test.

CHAPTER IV

ANALYSIS AND INTERPRETATION OF DATA

The AAHPER Youth Fitness Test and Cooper's Twelve-Minute Test were administered to forty-seven women physical education majors at The University of North Carolina at Greensboro during April of 1969. The scores obtained were studied in the following ways:

1. The total scores of the two tests were correlated from original data by means of the Pearson r. This relationship was studied to determine if the two tests reflected the same or similar aspects of fitness and to determine whether the two were highly enough related to be used interchangeably.
2. Each item of the AAHPER battery was correlated from raw scores with the total AAHPER battery to determine which ones were most highly related to a total T-score of the battery.
3. Individual AAHPER items, using raw scores, were also correlated with the Twelve-Minute Test score to see which were most closely related to it. These correlation coefficients would indicate which items, if any, are most useful in measuring the cardiorespiratory fitness variables.

4. The final relationship studied related the T-score totals of the AAHPER test to the fitness categories indicated by Cooper as a classification of present fitness status. This would be a rough indication of the relationship existing between the AAHPER scores and the levels of fitness based on oxygen consumption per kilogram of body weight per minute.

The correlation coefficients were accepted as significant at or above the .05 level.

The original data were treated first to determine the range, mean, and standard deviation for each of the seven items of the AAHPER Youth Fitness Test as well as for the total T-scores, and the distances on the Twelve-Minute Test. This information is summarized in Table V. The T-scores used in this study were those based on the norms for women physical education majors at The University of North Carolina at Greensboro.

This information is perhaps of even greater interest when the means of the AAHPER items as shown in Table V are compared to the means of the general college women as indicated by the national norms. Table VI shows this comparison. In every case, the physical education majors scored much higher as a group. This indicated that, for motor fitness measured by the AAHPER test, the group tested appeared to be superior to the general college population.

As shown in Table VII the individual items of the AAHPER battery correlated significantly in every case with the T-score total of the same test. This is to be expected since the T-score

TABLE V

RANGE, STANDARD DEVIATION, AND MEAN OF VARIOUS FITNESS MEASURES

Item of Test	N	Range	S.D.	M
Bent-arm hang	46	0-47 sec.	10.0903	11.4783
50-yard dash	47	9.2-6.0 sec.	.5321	7.8894
Softball throw	47	60-164 feet	26.8715	106.0851
Shuttle run	47	12.5-9.5 sec.	.6187	10.7128
Sit-up	47	6-50 times	12.2742	33.3617
Standing broad jump	47	52 - 87 inches	7.4195	69.8085
600-yard walk-run	47	191-121 sec.	17.2297	146.5745
T-score total (AAHPER)	46	228-439 t-score	47.7572	345.0870
Twelve-minute raw score	47	.875-1.7 miles	.23427	1.2931

TABLE VI

COMPARATIVE PERFORMANCE ON THE AAHPER TEST ITEMS

AAHPER Item	Mean UNC-G Group N = 146	Mean National Norms for College Women
Bent-arm hang	11.48 sec.	-
50-yard dash	7.89 sec.	8.4 sec.
Softball throw	106.90 feet	70 feet
Shuttle run	10.71 sec.	11.6 sec.
Sit-up	33.36 times	20 times
Standing broad jump	69.81 inches	64 inches
600-yard walk-run	146.57 sec.	178 sec.

TABLE VII

CORRELATION COEFFICIENTS BETWEEN THE ITEMS OF THE AAHPER TEST AND THE AAHPER T-SCORE TOTALS

AAHPER Item	N	Pearson r
Bent-arm hang	46	.6106 *
50-yard dash	46	.7115 *
Softball throw	46	.5439 *
Shuttle run	46	.7307 *
Sit-up	46	.4870 *
Standing broad jump	46	.6983 *
600-yard walk-run	46	.7065 *

* Coefficient of .291 necessary to be significant at the .05 level of confidence for 44 degrees of freedom.

total was the composite of the items. The strongest relationship existed between the T-score total and the shuttle-run which showed an r of .7307. However, almost as highly correlated were the 50-yard dash (r = .7115), the 600-yard walk-run (r = .7065), and the standing broad jump (r = .6983). The relative importance of the three running events is noteworthy as is the fact that the four items with the highest coefficients all involve use of the legs. This is probably due to the heavy weighting of the running items in the total battery, although they are present to measure different aspects of motor fitness. The bent-arm hang (r = .6106), softball throw (r = .5439), and sit-ups (r = .4870) were not so highly related, yet they, along with the previous four items, were all significant to the .01 level of confidence.

The relationships between the AAHPER items and the Twelve-Minute Test are shown in Table VIII. Five of the seven items show significant relationships. They are the 600-yard walk-run (r = .4977), the softball throw (r = .3942), the standing broad jump (r = .3720), the shuttle run (r = .3348), and the bent-arm hang (r = .2988).

It was to be expected that the item on the AAHPER battery purported to measure cardiorespiratory endurance, the 600-yard walk-run, would show the greatest relationship. However, the two other running items which had related highly in some previous studies (40, 56, 72) ranked far down the list, and the 50-yard dash did not show a significant relationship in the present study. The sit-ups showed very low relationship with the Twelve-Minute Test

TABLE VIII

CORRELATION COEFFICIENTS BETWEEN THE ITEMS OF THE AAHPER TEST AND THE TWELVE-MINUTE TEST

AAHPER Item	N	Pearson r
Bent-arm hang	46	.2988 *
50-yard dash	47	.2366
Softball throw	47	.3942 *
Shuttle run	47	.3348 *
Sit-up	47	.0818
Standing broad jump	47	.3720 *
600-yard walk-run	47	.4977 *

* Coefficient of .291 necessary to be significant at the .05 level of confidence for 44 degrees of freedom. Coefficient of .288 necessary to be significant at the .05 level of confidence for 45 degrees of freedom.

as it has in the studies referred to above when compared to measures of cardiorespiratory fitness. In fact, in each case it has shown the lowest relationship of any item to the maximal oxygen intake criterion. It is interesting to note that it also had the lowest relationship with the T-score total of the AAHPER battery.

From Table IX it is evident that the correlation coefficients found in this study are lower than in studies done by Olree, et. al. (56), Corroll (72), and Falls, Ismail, and MacLeod (40) in which the relationship between the items of the AAHPER test were compared to direct measures of cardiorespiratory fitness. The indirectness of the measure of the Twelve-Minute Test would be expected to show less relationship, yet five of the items were significantly related at the .05 level of confidence or better. Another factor that might cause differences to appear is the fact that these studies all involved men subjects while the present one used women. From a comparison of these results, it is evident that without exception the 600-yard walk-run item was related most closely while the sit-ups showed the lowest relationship. No real pattern of ranking is apparent in the other items.

The T-score total of the AAHPER Youth Fitness Test was correlated to both the Twelve-Minute Test distance and the Cooper Fitness Categories. The results are shown in Table X. The relationship between the raw score from the Twelve-Minute Test and the T-score total was .4823 while that of the more grossly divided categories designed for men was .4638. Both are significant at or above the .01 level of confidence. It would appear that stating results

TABLE IX

CORRELATION COEFFICIENTS FROM VARIOUS STUDIES OF THE AAHPER TEST ITEMS AND THEIR RELATIONSHIP TO TESTS OF CARDIORESPIRATORY FITNESS

AAHPER Item	Olree (56) Males Age 16-17 N = 76	Corroll (72) Males Age 11 N = 119	Falls, Ismail, MacLeod (40) Males Age 23-58 N = 87	Current Study Females College Age N = 46
Pull-up or bent-arm hang	.293	.454	.4770	.2988
50-yard dash	.480	.557	.4832	.2366
Softball throw	.430	.313	-	.3942
Shuttle run	.374	.543	.6145	.3348
Sit-ups	.226	.308	.4036	.0818
Standing broad jump	.444	.536	.4667	.3720
600-yard walk-run	.532	.689	.6443	.4977

TABLE X

CORRELATION COEFFICIENTS BETWEEN TOTAL MEASURES OF THE AAHPER TEST AND THE TWELVE-MINUTE TEST

Tests	N	Pearson r
T-score total and Twelve-Minute Test raw score	46	.4823 *
T-score total and Twelve-Minute Test categories	46	.4638 *

* Coefficient of .291 necessary to be significant at the .05 level of confidence for 44 degrees of freedom.

of the Twelve-Minute Test in categories could be useful in indicating the cardiorespiratory fitness as related to motor fitness, although they are not fine measurements. This would give an estimate of the maximal oxygen as shown from Table III, page 29.

No attempt was made to equate the total T-scores on the AAHPER test with maximal oxygen consumption as indicated by the fitness categories. However, in Table XI there is a breakdown of average T-scores within each category as measured in the present study. These categories are for men and will undoubtedly differ for women when they are available. These categories do differentiate, however, between levels of fitness for women even though the amounts of oxygen consumed are almost certainly different for women than for men. Although no women performed in the excellent category, the mean T-score gradually increased in Group I through Group IV from 44.67 to 53.45.

The rationale for use of a given test is always dependent on the objective of the tester. However, it would appear that the Twelve-Minute Test might well be used to measure the fitness of large groups of people and give a comparable picture to that offered by the administration of the AAHPER test.

It is evident that each item of the AAHPER battery is a significant indicator of motor fitness, yet it is doubtful if any one alone could be substituted for the battery. Five of the items seem also to have some relationship to the picture of circulo-respiratory fitness as measured by the Twelve-Minute Test. They are the 600-yard walk-run, the softball throw, the standing broad

TABLE XI

RANGE, STANDARD DEVIATION, AND MEAN FOR THE T-SCORE AVERAGE WITHIN EACH OF COOPER'S CATEGORIES OF FITNESS FOR MEN

Cooper's Categories for Men	N	T-Score Average		
		Range	S.D.	M
I = very poor	6	33-55	7.1802	44.67
II = poor	16	33-56	6.6494	46.69
III = fair	13	43-62	5.0279	50.86
IV = good	11	46-63	5.3997	53.45
V = excellent	0	-	-	-

jump, the shuttle run, and the bent-arm hang. Again, none of these, including the 600-yard walk-run, is as adequate a measure of the cardiorespiratory fitness as is the Twelve-Minute Test.

There does seem to be a relationship between the T-scores of the AAHPER test and the categories of the Twelve-Minute Test corresponding to the maximal oxygen consumption. The maximum oxygen consumption was not studied directly.

CHAPTER V

SUMMARY AND CONCLUSIONS

This study attempted to analyze relationships between the AAHPER Youth Fitness Test, a measure of motor fitness, and the Twelve-Minute Test used by Dr. Kenneth Cooper to measure cardiorespiratory fitness. The former test measures various aspects of motor fitness, while the latter gives an overall picture of physiological fitness as indicated by the maximal oxygen intake measured indirectly in milliliters per kilogram of body weight per minute. The tests were administered to women physical education majors at The University of North Carolina at Greensboro.

A review of the literature revealed that little has been done toward relating these two tests, probably due to the newness of the Cooper test. Two studies were found in which the 600-yard walk-run item in the AAHPER test had been studied against the Twelve-Minute Test. (39, 74) Further review revealed that other studies had been done relating the AAHPER test to direct measures of cardiorespiratory fitness or maximum oxygen intake. (40, 56, 72) This present investigation undertook to search for relationships between the AAHPER battery and the indirect measure of maximum oxygen intake known as the Twelve-Minute Test.

Correlation coefficients were computed using the original data by means of the Pearson r. Significance was to be acceptable at the .05 level of confidence. Significant relationships were

found to exist between the T-score totals of the AAHPER test and both the distance covered and the fitness categories of the Twelve-Minute Test. Other significant relationships were found between each item of the AAHPER battery and the T-score total of the AAHPER battery.

Significant relationships were likewise evident between the 600-yard walk-run, softball throw, standing broad jump, shuttle run, and bent-arm hang items of the battery and the Twelve-Minute distance. The subjects scored well above the national averages based on the general college population for the AAHPER test. Their mean distance on the Twelve-Minute Test was 1.2931 miles. This is extremely close to the 1.3 miles distance which Cooper has predicted will mark the "Good" category for women when standards for them are available. The subjects were all active yet none were participating in a formal conditioning program.

CONCLUSIONS

The Twelve-Minute Test is significantly related to the T-score totals of the seven fitness items and may be used to give an indication of motor fitness as well as circulorespiratory fitness. In addition, the categories of fitness tend to differentiate adequately levels of average motor performance. The relationship is not so strong that these tests may be used interchangeably.

The items of the AAHPER battery are all significantly related to the T-score totals, yet none is so closely related that it could be used in place of the total battery.

Five of the AAHPER battery items relate significantly to the Twelve-Minute Test. Not even the one purported to measure cardiorespiratory endurance, the 600-yard walk-run, is adequate to be used alone to give the picture of cardiorespiratory fitness offered by the Twelve-Minute Test.

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APPENDICES

APPENDIX A

Tests of Physical Fitness

CARDIORESPIRATORY TESTS OF PHYSICAL FITNESS

Bicycle Ergometer Tests:

- Astrand Bicycle Ergometer Test
- Astrand-Rhyming Nomogram Test
- Astrand-Saltin Test
- Binkhorst and VanLeeuwen Test
- PWC-170 Test
- Wahlund Test
- Wyndham Test

Non-performance Tests:

- Barach Index
- Burger Test
- Crampton Blood Ptosis Test
- McCurdy Condition Test
- Melan Physical Fitness Test
- Stone's Test
- Tigerstedt's Test
- Turner Test of Circulatory Reaction to Prolonged Standing

Running Board Test:

- Woodall Test

Running in Place Tests:

- Carlson Fatigue Curve Test
- Foster's Test of Circulatory Efficiency
- Michigan Test

Step Tests:

- Elbel and Holmer Exercise Test
- Gallagher and Brouha Test for Girls
- Gallagher and Brouha Test for High School Boys
- Harvard Step Test
- McCloy's Cardiovascular Rating of "Present Condition"
- McCurdy-Larson Organic Efficiency Test
- Pack Test
- Progressive Pulse Ratio Test
- Schneider Test
- Skubic and Hodgkins Test
- Sloan Test
- Tuttle Pulse Ratio Test

Treadmill Tests:

Balke Treadmill Test
Bruce, Blackman, Jones, and Straight Test
Cureton All-out Treadmill Run Test
Mitchell, Sproule, and Chapman Test
Newton Test
Slonim, Gillespie, and Harold Test
Taylor, Buskirk, and Henschel Test

MOTOR TESTS OF PHYSICAL FITNESS

Tests from the military:

- Army Air Force Physical Fitness Test
- Army Physical Efficiency Test
- Navy Standard Physical Fitness Test

Tests from state departments of education:

- California Physical Performance Test
- Illinois High School Physical Condition Test
- Indiana Physical Fitness Test
- Minnesota Physical Efficiency Test
- New York State Physical Fitness Test
- North Carolina Fitness Test
- Oregon Motor Fitness Tests
- Virginia Physical Fitness Test

Tests by individual investigators:

- Anderson Strength Index for High School Girls
- Carpenter Strength Test
- Cozens All-around Athletic Classification Index Test
- Cureton Flexibility Test
- Cureton Formulae for Predicting Muscular Endurance
- Elementary School Motor Fitness Test
- JCR Test
- Johnson, Brouha, Darling Physical Fitness Test
- Kraus-Weber Test of Minimum Muscular Fitness
- Larson Dynamic Strength Test
- Leighton Flexometer Test
- McCloy Athletic Strength Index
- MacCurdy Test of Physical Capacity
- Mohr Test
- O'Conner-Cureton Motor Fitness Test for High School Girls
- Rogers Strength Index and Physical Fitness Index
- Wendler Strength Index

Test of organizations:

- AAHPER Youth Fitness Test
- DGWS Tests

APPENDIX B

Correspondence

KENNETH H. COOPER, M. D.
Lieutenant Colonel, U.S.A.F. Medical Corps
110 Inspiration Drive
San Antonio, Texas 78228

C
O
P
Y

December 30, 1968

Miss Karla R. Johnston
Box 521 Spencer Annex
University of North Carolina
Greensboro, North Carolina

Dear Miss Johnston:

Thank you for your letter of 19 December 1968 and your expressed interest in the aerobic conditioning program. I would be most interested in knowing the results of your study comparing the test given by the American Association for Health, Physical Education and Recreation as compared to 12-minute performances. You might be interested in knowing that a group of 432 men who had been following the 5BX program at least 3 times per week were recently tested on the 12-minute test. Only 35% could meet the requirement adjusted to their age. A larger group of people who had not been participating in any exercise program achieved a 39% passing rate.

Again, I regret to inform you that I do not have any appreciable data accumulated on the response of women to the 12-minute test. I did perform one study on 266 airman WAFS with an average age of 18.6 years. Their performance at the beginning and end of training is documented in the following chart:

12-Minute Performance Data
266 Airman WAFS

	Before	After 6 Weeks Training
<1.0 miles	5.6%	3.4%
1.0-1.24	71.4%	45.5%
1.25-1.49	22.6%	48.5%
1.50-1.74	0.4%	2.6%
>1.75	0.0	0.0
Average Distance	1.16 mi.	1.24 mi.

The six week training program utilized in the above study was not one of the aerobic conditioning programs. However, this indicated to us that there would be considerable difficulty using the same

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performance levels for females as we used for males on the 12-minute test. A study was recently done at Grossmont Jr. College, El Cajon, Calif. by Miss Dorothy Arnold. She utilized the 12-minute test on a large number of their female students. However, I do not know the results of that study.

Starting in February 1969, we will be working extensively with the airman WAF personnel. We hope to develop more realistic physical fitness categories for women of various ages. At present, I am unable to say what is the passing level for women of various ages.

We have recently expanded the categories of fitness according to age using a standard distance of 1.5 miles. This fitness chart will probably be used in the new Air Force conditioning program when and if it is accepted. It will also be found in the forthcoming sequel to "Aerobics" to be published this next summer.

You certainly have my permission to use the physical fitness classification based on 12-minute performance in your thesis.

I am afraid that I have not been too helpful to you but if you feel I can be of further assistance, please feel free to contact me.

Sincerely,

(signed)

Kenneth H. Cooper, M.D.

KHC/mc

GROSSMONT COLLEGE
Grossmont Junior College District

8800 Grossmont College Drive
El Cajon, California 92020

C
O
P
Y

March 7, 1969

Miss Karla R. Johnston
%Dr. Rosemary McGee, Advisor
Box 521
Spence Annex
University of North Carolina
Greensboro, North Carolina

Dear Miss Johnston,

We did not administer the Twelve-minute Run-walk Test as presented in Dr. Cooper's "Aerobics." In talking with Dr. Cooper, the problems inherent in this test when testing on a mass basis are obvious ones, since you have individuals stopping at various places around the track. Dr. Cooper, in further research, has correlated a set distance timed, with the Twelve-minute Run-walk Test. Therefore, based upon Dr. Cooper's findings, our men ran a timed mile and a half. The mean was ten minutes, six seconds. Our women ran a timed mile and three-tenths. The mean was twelve minutes, nine seconds. These were deconditioned men and women. The age span was seventeen through twenty-one. Dr. Cooper was very pleased with our results. He suggested that next year we alter the women's distance to a mile and a quarter. This would probably give us a mean score of twelve minutes.

We were very pleased with the performance of our students. I am enclosing the distribution of scores and the breakdown of the five categories for both men and women.

The women's results were as follows:

Mean	=	12.887	
Standard deviation	=	1.557	
Mode	=	12.5	
Median	=	12.6	(approximate)
Number of Bodies		678	

Five categories - ladies spread

Time		F.	
9.00	-	2	
9.50	-	6	Excellent
10.00	-	19	
		10.5	

Time		F.	
10.50	-	25	
11.00	-	40	
11.50	-	60	Good
12.00	-	76	
		12.50	
12.50	-	103	
13.00	-	95	Fair
13.50	-	74	
		13.7	
14.00	-	63	
14.50	-	41	Poor
15.00	-	23	
		15.3	
15.50	-	25	
16.00	-	9	
16.50	-	6	
17.00	-	4	Very poor
17.50	-	4	
18.50	-	1	
19.00	-	2	

The men's results were as follows:

Mean	=	10.672	
Standard deviation	=	1.295	
Mode	=	10.5	
Median	=	10.58	(approximate)
Bodies		1087	

Time		F.	
7.50	-	6	
8.00	-	11	Excellent
8.50	-	30	
		8.72	
9.00	-	77	
9.50	-	141	Good
10.00	-	148	
		10.01	
10.50	-	179	
11.00	-	178	Fair
		11.31	
11.50	-	158	
12.00	-	55	Poor
12.50	-	35	
		12.62	

Time		F.	
13.00	-	26	
13.50	-	20	
14.00	-	6	
14.50	-	9	Very poor
15.00	-	6	
17.50	-	1	
18.50	-	1	

Dorothy Arnold is on Sabbatical leave this spring semester and is working with Dr. Cooper at Lackland A.F.B. testing the women in the Air Force. We are looking forward to her return and the wealth of knowledge she will have gained. I hope this information will be of some help. If you would like the range of scores from high to low I would be glad to send you a copy.

Sincerely yours,

(signed)

(Miss) Gay Cox
Instructor
Grossmont College

GC:jp
encl.

APPENDIX C

Test Materials and Information

I agree to participate in the Aerobics Run-walk Test. To my knowledge I have no physical disabilities that would bar my participation in this or the AAHPER Fitness Test.

I would prefer to take the test on:

_____ Monday, April 14, 1969, at 5:00 p.m.

_____ Tuesday, April 15, 1969, at 5:00 p.m.

_____ Wednesday, April 16, 1969, at 5:00 p.m.

_____
signature

FIGURE 1

APPOINTMENT FORM FOR THE TWELVE-MINUTE TEST

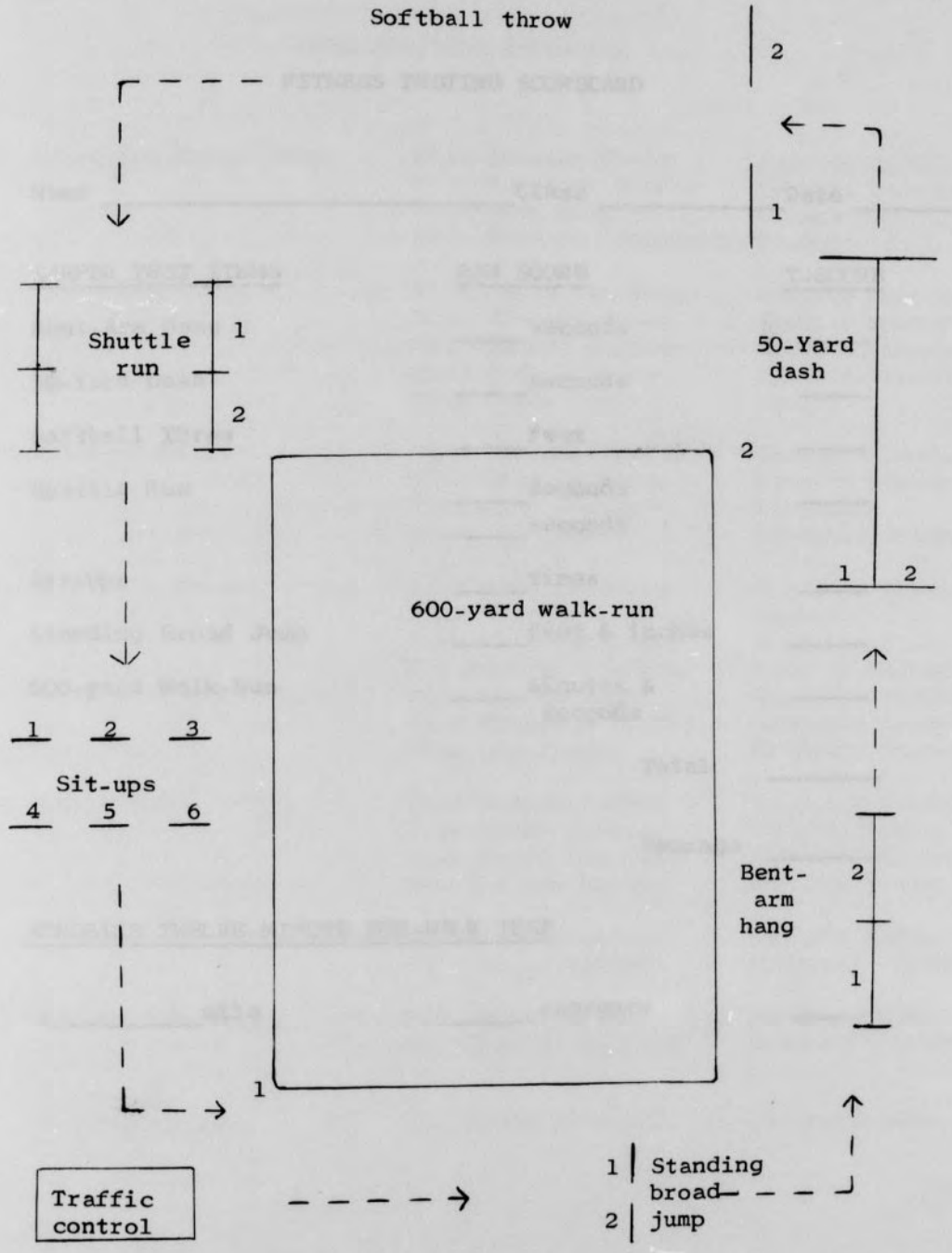

FIGURE 2

FIELD LAYOUT, ROTATION ORDER, AND NUMBER OF STATIONS AT EACH TEST AREA FOR THE AAHPER YOUTH FITNESS TEST

FITNESS TESTING SCORECARD

Name _____ Class _____ Date _____

AAHPER TEST ITEMS	RAW SCORE	T-SCORE
Bent-Arm Hang	_____seconds	_____
50-Yard Dash	_____seconds	_____
Softball Throw	_____feet	_____
Shuttle Run	_____seconds _____seconds	_____
Sit-Ups	_____times	_____
Standing Broad Jump	_____feet & inches	_____
600-yard Walk-Run	_____minutes & seconds	_____
	Total	_____
	Average	_____

AEROBICS TWELVE-MINUTE RUN-WALK TEST

_____mile	_____category	_____

FIGURE 3

SCORE CARD FOR THE AAHPER YOUTH FITNESS TEST
AND THE TWELVE-MINUTE TEST

ADMINISTRATIVE PERSONNEL

1.	Standing Broad Jump:	Miss Dorothy Davis	Faculty Member
		Miss Margaret Greene	Faculty Member
		Miss Judy Rink	Graduate Student
		Miss Genelle Samuelson	Graduate Student
2.	Bent-Arm Hang:	Miss Anita Childrey	Faculty Member
		Miss June Galloway	Faculty Member
		Mr. Charles Higgins	Graduate Student
		Miss Judy Showers	Graduate Student
		Miss Carol Wally	Senior
3.	50-Yard Dash:	Miss Dorothy Alston	Graduate Student
		Miss Elsa Heimerer	Faculty Member
		Miss Lynn Jessup	Freshman
		Miss Ann Lambert	Graduate Student
4.	Softball Throw:	Miss Joan DeSantis	Graduate Student
		Miss Shirley Ferguson	Senior
		Miss Kristina Klaus	Graduate Student
		Dr. Pauline Loeffler	Faculty Member
		Miss Louise Rozzi	Graduate Student
		Miss Minnette Starts	Graduate Student
		Miss Joy Taylor	Graduate Student
5.	Shuttle-Run:	Miss Andrea Farrow	Graduate Student
		Miss Lynne Gaskin	Faculty Member
		Miss Bette Ann LeFort	Graduate Student
		Mr. William Russell	Faculty Member
6.	Sit-Ups:	Miss Mary Rockwood	Faculty Member
		Miss Diane Walker	Graduate Student
7.	600-Yard Run-Walk:	Miss June Galloway	Faculty Member
		Mr. Charles Higgins	Graduate Student
	Traffic Control:	Dr. Rosemary McGee	Faculty Member

DESCRIPTIONS OF TEST ITEMS FOR ADMINISTRATIVE PERSONNEL

AAHPER YOUTH FITNESS TEST (1)

Bent-Arm Hang

Description: The bar should be approximately equal to the subject's standing height. The overhand grip should be used (knuckles toward the face). With the assistance of two spotters, one in the front and one in the back of the subject, the subject steps from the stool to a position where the chin is above the bar, the elbows are flexed and the chest is close to the bar. The subject holds this position against a time criterion for as long as possible.

Instructions: Grasp the bar with an overhand grip and position yourself where your chin is just above the bar. Hold this position for as long as you are able. You will be timed from the time you take this position until either of the following takes place: (a) your chin touches the bar, (b) your head tilts backwards to keep the chin away from the bar, or (c) your chin falls below the bar.

Scoring: Record to the nearest second the length of time the subject holds the starting position.

50-Yard Dash

Description: After a short warm-up period the student takes his position behind the starting line. The starter gives the command, "Are you ready?" and "Go!" As he says the latter, he fires the starter's gun as a signal to the timer. The students should run two at a time and should be reminded to run across the finish line. One trial is permitted.

Instructions: You may take any position behind the starting line that you wish. On the command, "Are you ready?" and "Go!", you are to run as fast as you can across the finish line. Do not slow up until you are across the finish line.

Scoring: The score is the elapsed time to the nearest tenth of a second between the starting signal and the instant the subject crosses the finish line.

Softball Throw for Distance

Description: Two parallel lines six feet apart designate the throwing area. The throw must be made from within this area. The student, using an overhand throw, throws the ball straight down the field. Steps may be taken in making the throw provided the student remains in the six-foot restraining area. Three

DESCRIPTIONS OF TEST ITEMS FOR ADMINISTRATIVE PERSONNEL

AAHPER YOUTH FITNESS TEST (1)

Bent-Arm Hang

Description: The bar should be approximately equal to the subject's standing height. The overhand grip should be used (knuckles toward the face). With the assistance of two spotters, one in the front and one in the back of the subject, the subject steps from the stool to a position where the chin is above the bar, the elbows are flexed and the chest is close to the bar. The subject holds this position against a time criterion for as long as possible.

Instructions: Grasp the bar with an overhand grip and position yourself where your chin is just above the bar. Hold this position for as long as you are able. You will be timed from the time you take this position until either of the following takes place: (a) your chin touches the bar, (b) your head tilts backwards to keep the chin away from the bar, or (c) your chin falls below the bar.

Scoring: Record to the nearest second the length of time the subject holds the starting position.

50-Yard Dash

Description: After a short warm-up period the student takes his position behind the starting line. The starter gives the command, "Are you ready?" and "Go!" As he says the latter, he fires the starter's gun as a signal to the timer. The students should run two at a time and should be reminded to run across the finish line. One trial is permitted.

Instructions: You may take any position behind the starting line that you wish. On the command, "Are you ready?" and "Go!", you are to run as fast as you can across the finish line. Do not slow up until you are across the finish line.

Scoring: The score is the elapsed time to the nearest tenth of a second between the starting signal and the instant the subject crosses the finish line.

Softball Throw for Distance

Description: Two parallel lines six feet apart designate the throwing area. The throw must be made from within this area. The student, using an overhand throw, throws the ball straight down the field. Steps may be taken in making the throw provided the student remains in the six-foot restraining area. Three

trials are permitted and taken in succession. Only the farthest throw is marked and recorded.

Instructions: You must make your throw from within the space bounded by the two lines. You must throw the ball overhand, and it will be to your advantage to throw it as straight as possible. We will record the farthest of three throws.

Scoring: The score is the best of the three trials measured to the nearest foot.

Shuttle Run

Description: The student stands at a line thirty feet opposite the two blocks. On the signal to start, the student runs to the blocks, takes one and returns to the starting line where he places the block behind that line. He then returns to pick up the second block which he carries across the starting line. Two trials are permitted but some brief rest should intervene. There will be two lines at each of the two stations to facilitate the administration of this item.

Instructions: On the signal, "Are you ready?" and "Go!", you must run as fast as you can to the next line and pick up a block. You should return the block to the starting line where you place it on the ground. Do not throw it. You return for the second block and this time you may run across the starting line as fast as you can without stopping to place the block on the ground.

Scoring: The score is the elapsed time recorded in seconds and tenths of seconds for the better of two trials.

Sit-Ups

Description: The student lies flat on his back with his knees straight and his feet approximately two feet apart. His fingers are interlocked and placed behind his neck. His elbows are flat against the ground. His feet are held by a partner who should also count for him. On the signal to start, the student sits up touching the left elbow to the right knee, returns to the original starting position, sits up again and touches the right elbow to the left knee, and returns. This is repeated, alternating sides. Each time an elbow touches a knee, one point is scored.

Instructions: Your fingers must remain interlocked and in contact with the back of your neck at all times. You may curl up from the starting position with your knees straight. They may be bent slightly when you are touching them with the elbow. When

you return to the starting position, your elbows must be flat on the ground or mat.

Scoring: One point is scored for each correct sit-up. The maximum number of sit-ups is fifty for girls and 100 for boys.

Standing Broad Jump

Description: The student stands behind a take-off line with feet several inches apart. Preliminary to jumping, the student dips his knees and swings his arms backward. He then jumps forward by simultaneously extending his knees and swinging his arms forward. Three trials are permitted. Measurement is from the closest heel mark to the take-off line.

Instructions: You must take off from both feet simultaneously, jump as far forward as possible, and land on both feet. Try not to fall backward after landing. You can jump farther by crouching before the jump and swinging your arms. You will have three trials and the best one will be recorded.

Scoring: The score is the distance between the take-off line and the nearest point where any part of the student's body touches the ground. Measurement is to the nearest inch. Only the best of the three trials is recorded.

600-Yard Run-Walk

Description: Any size group may be paired so one portion runs while the other listens for the time of the runner to be called. Then they will switch. The student may intersperse his running with walking and should be encouraged to pace himself. When a group is running, the timer should call out times as each student crosses the finish line.

Instructions: You should run as far as you can and then you may have to walk for a short space of time. Try to keep running as much as possible, yet pace yourself at a speed you think you can continue. Your partner will listen for your time as you cross the finish line.

Scoring: The score is the elapsed time in minutes and seconds.

TWELVE-MINUTE TEST **(5)**

Description: The subject should begin running around the quarter-mile track when the starter's gun sounds. He should move at a pace he feels he can maintain for twelve minutes. If he feels that he can run no longer, he should walk until he is able to

run again, then continue to alternate as he needs. The test ends when the gun sounds again at the end of twelve minutes.

Instructions: Begin running at a pace that you feel you can maintain when the starter's gun sounds. When you cannot run farther, walk until you can run again. Keep moving until the gun sounds the second time. When the test ends, take note of the flag marker you just passed and the number of laps you have completed and report this information to the recorder. You may warm up before you begin and you should keep walking to cool off at the completion of the test.

Scoring: From the conversion table (Table XII), find the column of the lap which the subject was running when time was up. Read down to the letter he had last passed. This distance is the mile or portion of a mile that was completed.

TABLE XII

TABLE TO CONVERT LAPS AND DISTANCE MARKERS INTO MILES

Marker Letters	LAP							
	1st	2nd	3rd	4th	5th	6th	7th	8th
A	.025	.275	.525	.775	1.025	1.275	1.525	1.775
B	.05	.30	.55	.80	1.05	1.30	1.55	1.80
C	.075	.325	.575	.825	1.075	1.325	1.575	1.825
D	.10	.35	.60	.85	1.10	1.35	1.60	1.85
E	.125	.375	.625	.875	1.125	1.375	1.625	1.875
F	.15	.40	.65	.90	1.15	1.40	1.65	1.90
G	.175	.425	.675	.925	1.175	1.425	1.675	1.925
H	.20	.45	.70	.95	1.20	1.45	1.70	1.95
I	.225	.475	.725	.975	1.225	1.475	1.725	1.975
J	.25	.50	.75	1.00	1.25	1.50	1.75	2.00

APPENDIX D

Raw Data

TABLE XIII

RAW DATA

Ss	Bent-arm Hang (Seconds)	50-Yard Dash (Seconds)	Softball Throw (Feet)	Shuttle-run (Seconds)	Sit-Ups (Number)	Standing Broad Jump (Inches)	600-Yard Walk-Run (Seconds)	T-Score Total	12-Minute Test (Miles)	Cooper Category of Fitness
1	2	8.1	135	10.8	30	83	151	356	1.3	3
2	4	8.3	90	10.7	28	69	160	314	1.125	2
3	3	8.5	110	12.0	6	67	160	272	.875	1
4	13	7.9	70	10.7	23	67	122	337	1.45	3
5	14	8.4	116	11.2	31	65	143	331	1.25	3
6	2	9.1	100	10.9	32	59	188	229	1.125	2
7	1	8.3	91	10.9	24	58	145	299	1.3	3
8	9	7.7	65	10.7	32	67	155	325	1.475	3
9	33	7.5	111	10.3	31	72	152	383	.975	1
10	10	7.0	105	9.5	25	81	121	406	1.5	4
11	20	7.6	111	10.4	50	76	139	395	1.325	3
12	10	8.4	110	10.7	50	56	156	332	1.05	2
13	16	7.9	71	10.4	34	73	149	306	1.05	2
14	12	7.5	87	10.9	31	76	135	357	1.2	2
15	1	9.2	60	12.1	30	57	191	228	.975	1
16	13	8.2	73	10.6	42	66	140	340	1.2	2
17	11	7.8	143	11.1	50	66	144	366	1.125	2
18	1	6.0	80	11.1	50	61	162	351	.9	1
19	6	8.0	73	10.7	31	70	154	323	1.2	2
20	15	8.2	77	11.3	50	71	127	352	1.15	2
21	0	8.4	76	10.8	13	56	135	287	1.15	2
22	9	8.1	73	11.2	10	66	172	282	1.20	2

TABLE XII--Continued

Ss	Bent-arm Hang (Seconds)	50-Yard Dash (Seconds)	Softball Throw (Feet)	Shuttle-run (Seconds)	Sit-Ups (Number)	Standing Broad Jump (Inches)	600-Yard Walk-Run (Seconds)	T-Score Total	12-Minute Test (Miles)	Cooper Category of Fitness
23	3	7.5	157	10.3	26	76	141	377	1.225	2
24	9	7.8	164	10.3	50	65	122	397	1.55	4
25	12	7.3	126	10.3	30	70	139	375	1.30	3
26	21	8.0	154	10.7	29	63	130	368	1.6	4
27	4	7.9	96	10.8	28	63	138	327	.975	1
28	6	7.7	120	11.0	16	69	134	338	1.675	4
29	1	8.0	104	12.2	41	73	135	325	1.55	4
30	7	7.9	106	10.1	36	79	131	377	1.675	4
31	29	7.6	128	10.0	27	74	133	348	1.55	4
32	3	8.0	130	11.0	15	69	149	324	1.625	4
33	32	7.8	86	10.6	50	76	153	383	1.35	3
34	5	8.1	105	10.7	16	72	173	311	.9	1
35	4	7.9	137	10.0	50	75	136	392	1.15	2
36	24	7.5	107	10.2	30	80	140	389	1.425	3
37	20	8.4	110	10.2	50	70	146	372	1.3	3
38	12	7.9	139	10.2	38	70	147	374	1.575	4
39	27	7.6	140	9.5	50	77	121	439	1.65	4
40	20	7.2	147	10.3	50	75	138	417	1.7	4
41	0	8.8	102	12.5	35	52	186	240	1.10	2
42	47	7.0	130	10.4	33	87	144	437	1.45	3
43	7	7.7	131	10.0	32	74	148	373	1.225	2
44	11	7.9	85	10.7	15	76	185	311	1.325	3
45	14	7.7	90	10.7	27	73	146	348	1.375	3
46	--	8.0	95	11.5	41	67	144	---	1.45	3
47	5	7.5	70	10.3	50	74	129	361	1.175	2